

1. Why don't most light microscope use 30X ocular lenses for greater magnification? (3 points)

Because of the visual limit of human eye and the resolution of objective lenses of microscopy, we cannot recognize any further magnified objects made by more than 15X ocular lenses.

2. Describe the Gram-staining procedure and explain what happens to a bacterial cell at each step. What step in the procedure could be omitted without losing the ability to distinguish between gram-(+) and gram-(-) bacteria? Why? (5 points)

1. Sample preparation (heat fixation)
2. First Staining with crystal violet dye – cell wall stained with crystal violet dye
3. Mordanting with iodine – dye will be strongly bound with cell wall
4. Decolorization with ethanol – dye will be removed from cell wall depending on the thickness of cell wall
5. Counterstaining with safranin

Step 5 can be omitted. In step 4, **gram(+) (purple) and gram(-) (colorless)** cells can be recognized.

3. Under what circumstances would it be desirable to prepare specimens for the TEM by use of negative staining? Shadowing? Freeze-etching? (3 points)

Negative staining – to observe structure of viruses, bacterial gas vacuoles, etc.

Shadowing – to observe virus morphology, bacterial and archaeal flagella, and DNA

Freeze-etching – to observe intracellular (membraneous) structures

4. What is the difference between a microbial species and a strain? (4 points)

Microbial species are a collection of strains that share many stable properties

Strain is the descendant of a single, pure microbial culture.

5. Describe Koch's postulates. Why are pure cultures important to Koch's postulates (5 points)

Four steps in Koch's postulates.

Isolation of only one type of bacteria (pure culture) can confirm the causing agent of a bacterial disease.

6. Would microbiology have developed more slowly if Fanny Hesse has not suggested the use of agar? Give your reasoning (3 points).

Yes, it is because the isolation of pure culture could be more difficult without solid agar plate.

7. Why do some microbiologists consider the term prokaryote an inadequate descriptor? (3 points)

First description for prokaryote such as lacking a membrane-bound nucleus, a cytoskeleton, membrane-bound organelles and internal membranous structures is not valid and shows exceptions in modern microbiology.

8. What is the relevance of the surface area-to-volume ratio? (3 points)

Being small increases the surface-volume ratio (S/V ratio). As this ratio increases, **nutrient uptake and diffusion of molecule within the cell become more efficient, increasing growth rate.** Small size is more beneficial.

Shape affects the S/V ratio. **A rod shape has higher S/V ratio than a coccus.**

9. Why does peptidoglycan contain the unusual D-isomers of alanine and glutamic acid rather than the L-isomers observed in proteins? (3 points)

Peptidase degrades L-amino acid. So, the presence of D-amino acids protects against degradation by those peptidase.

10. With a few exceptions, the cell walls of gram-positive bacteria lack porins. Why is this the case (4 points)

Because of no outer membrane in gram-positive bacteria, it can make a leakage of cytoplasm.

11. What is the importance of bacterial cytoskeleton proteins? (4 points)

Like eukaryotic cells, they play important role in cell division, protein localization, and determination of cell shape

12. What features of mitochondria support the endosymbiotic hypothesis of their evolution? (3 points)

Similarity to the shape and size of bacteria
Closed circular DNA

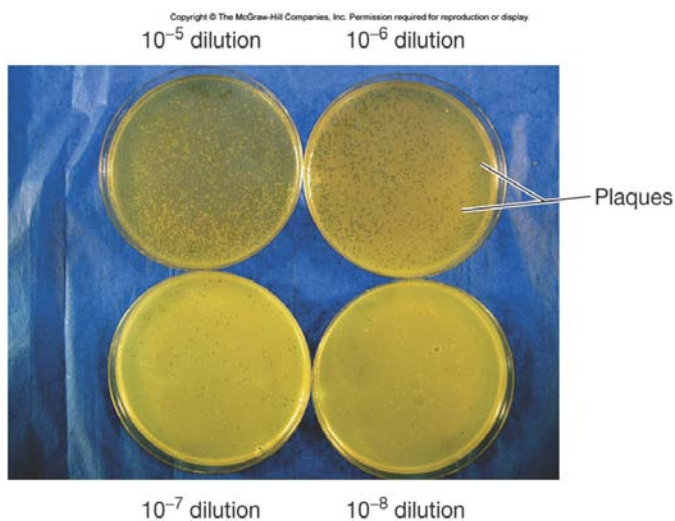
Ribosomes are the same size to bacteria
16s rRNA sequences are most similar to bacteria
Binary fission

13. What advantages might a phage gain by being capable of lysogeny? (4 points)

Lysogeny allows a phage to remain viable within a host (even in a dormant host) coping with a harsh environment.

In a high multiplicity of infection (MOI) environment, the phage can gain a reproduction strategy by enabling the survival of host cells.

14. Which plate would you use to calculate PFU per milliliter? Explain your choice (3 points).



10⁻⁷ dilution; because plaques on the plate are most clearly separated each other for counting

15. Discuss the ways in which organisms are classified based on their requirements for energy, carbon and electrons (4 points)

Energy source: chemotroph (organic chemicals), phototroph (light energy)
Carbon source: autotroph (CO₂ fixation), heterotroph (organics)
Electron source: organotroph (organics), lithotroph (inorganics)

16. What growth factor(s) do you think the red blood cells in blood agar media mainly provide? (3 points)

Heme (iron-containing)

Define or describe following terms (2 points each)

17. Ladderane
18. Pleomorphic
19. The germ theory of disease
20. Hopanoids
21. Lysogeny
22. Temperate phage
23. Prophage
24. Curing
25. Episome
26. Hopanoids
27. Cytopathic effect

Please give full name of following acronyms

28. CSLM

29. SEM

30. SASP

31. PHB

32. LUCA

True or False

33. M. J. Berkeley demonstrated that the great potato blight of Ireland was caused by a fungus.
True False
34. Less than 1% of the earth's microbial population has been cultured in vitro.
True False

35. Edward Jenner's work in preventing rabies led to the use of the term vaccination to describe a type of procedure used in the prevention of disease.
True False
36. The criteria for establishing a causative link between a particular microorganism and a particular disease were first developed by Jacob Henle.
True False
37. Charles Chamberland developed porcelain filters that allowed other scientists to demonstrate that viruses are smaller than bacteria.
True False
38. All eukaryotes have a membrane-delimited nucleus.
True False
39. The first disease to be identified as being caused by a virus was anthrax.
True False
40. John Tyndall demonstrated that microorganisms present in the air are carried on dust particles.
True False
41. Agastino Bassi demonstrated that a type of silkworm disease was caused by a fungus and proposed that many diseases are caused by microorganisms.
True False
42. Robert Koch developed a vaccine that could be used to prevent anthrax.
True False

Fill the blank

43. All living organisms can be placed into one of three _____, each comprised of many kingdoms. domains
44. The study of fungi is referred to as _____. mycology
45. The branch of microbiology that deals with the mechanisms by which the human body protects itself from disease-causing organisms is called _____. immunology
46. An Italian physician, _____, challenged the concept of spontaneous generation by demonstrating that maggots don't arise from decaying meat but rather from developing fly eggs. Francesco Redi